



1200V Half-Bridge Silicon Carbide Power Module

GE12047CCA3

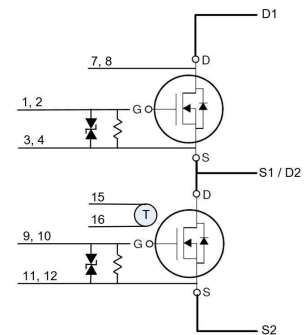
V_{DS} : 1200 V I_{DS} : 475 A

Superior performance for high power, high frequency applications needing best-in-class power density



Features

- Highly reliable GE SiC MOSFET devices AEC-Q101 qualified to 200°C
- Low $R_{DS(ON)}$ (3.1 m Ω) (device only)
- Low stray inductance (6 nH)
- Ultra-low switching losses over entire operating range
- GE Power Overlay wire-bondless technology
- Body diode with minimal reverse recovery
- Integrated temperature sensing
- Dedicated DESAT Pin and Source-Kelvin Pin
- AlSiC Baseplate and Si₃N₄ AMB Substrate



MOSFET DC Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I_{DS}	Continuous Drain Current			475		$V_{GS} = 20\text{ V}, T_c = 25^\circ\text{C}$	Per Switch
				333	A	$V_{GS} = 20\text{ V}, T_c = 100^\circ\text{C}$	
				272		$V_{GS} = 20\text{ V}, T_c = 125^\circ\text{C}$	
$I_{DS,pulse}$	Pulsed Drain Current			950	A	$T_c = 25^\circ\text{C}, t_p = 1\text{ ms}$	
V_{DSmax}	Drain - Source Breakdown Voltage	1200			V	$V_{GS} = 0\text{ V}, I_{DS} = 100\text{ }\mu\text{A}$	
V_{GSmax}	Maximum Gate - Source Voltage			-15/+23	V	$V_{DS} = 0\text{ V}$	
V_{GSop}	Recommended Gate - Source Voltage		-5/+20		V		
T_{Jmax}	Junction Temperature			175	$^\circ\text{C}$		
T_c	Case Temperature Range	-55		150	$^\circ\text{C}$		
T_{STG}	Storage Temperature Range	-55		150	$^\circ\text{C}$		
P_D	Power Dissipation			1250	W	$T_c = 25^\circ\text{C}$	



(Continued) **MOSFET DC Characteristics @ T_J = 25°C** (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I _{DS}	Continuous Drain Current			475	A	V _{GS} = 20 V, T _c = 25°C	Per Switch
V _{GS(th)}	Gate Threshold Voltage	2.5	2.8	4.5	V	V _{GS} = V _{DS} , I _{DS} = 160 mA	
I _{DSS}	Drain Leakage Current			0.10	mA	V _{DS} = 1200 V, V _{GS} = 0 V, T _J = 25°C T _J = 200°C	
				1.6			
I _{GSS}	Gate-Source Leakage Current			160	nA	V _{GS} = -15/+23 V	
R _{DS(on)}	On State Resistance (Device Only)		3.1	4.4	mΩ	V _{GS} = 20 V, I _{DS} = 475 A, T _J = 25°C T _J = 175°C	Per Switch
			5.6	6.8			
R _{G(int)}	Gate-Source series resistance		0.90		Ω	V _{GS} = 0 V, f = 100 kHz, T _c = 25°C	

MOSFET Dynamic Characteristics per switch @ T_J = 25°C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
C _{iss}	Input Capacitance		29.3		nF	V _{GS} = 0 V V _{DS} = 600 V f = 100 kHz	
C _{oss}	Output Capacitance		1.60		nF		
C _{rss}	Reverse Transfer Capacitance		0.13		nF		
E _{on}	Turn-On Switching Energy		7.72		mJ	V _{GS} = 0 V to +20 V V _{DS} = 800 V I _{DS} = 350 A R _{G(ext)} = 0 Ω	
E _{off}	Turn-Off Switching Energy		3.79		mJ		
t _r	Rise Time		21.9		ns		
t _f	Fall Time		38.9		ns		
Q _G	Total Gate Charge		1248		nC		
Q _{GD}	Gate-Drain Charge		536		nC	V _{GS} = 0 to 18 V V _{DS} = 900 V I _{DS} = 240 A	
Q _{GS}	Gate-Source Charge		176		nC		

Body Diode Characteristics per switch @ T_J = 25°C (unless otherwise specified)

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
I _{SD}	Pulsed body diode current			720	A	V _{GS} = 0 V	1.
V _{SD}	Diode Forward Voltage		4.69		V	V _{GS} = 0 V, I _{SD} = 475 A, T _J = 25°C	

1. Use of body diode is recommended in pulse mode only, with pulse duration up to 1 μs

Thermal Characteristics

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R _{th}	Thermal Resistance Junction-to-Case		0.10	0.12	°C/W	JESD51-14	Per Switch



Temperature Sensor Characteristics

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
R_{RTD}	Rated Resistance of RTD		1k		ohm		2.
	Tolerance of Resistance		0.12		%		
	Accuracy		0.3		°C		
	Measuring Current	100		300	μA		
TCR	Temperature Coefficient		3850		ppm/K		
	Operating Temperature	-70		+500	°C		
	Insulation Resistance		100		Mohm	20°C	

2. RTD is mounted directly over center-most die allowing direct reading of T_j

Module packaging data

Symbols	Parameters	Min.	Typ.	Max.	Unit	Test Conditions	Notes
V_{Iso}	Case Isolation Voltage	4			kV	AC 50 Hz, 1 min, 25°C	
CTI	Comparative Tracking Index		600				
M_s	Mounting Torque			5.0 4.0	N-m	Power Terminals Baseplate	
L_{D1S2}	Loop Inductance		6		nH		
	Module Mass		0.12		Kg		
	Clearance Distance		9		mm	D1 to S2	
			4		mm	D1 to S1/D2	
			23		mm	Pins 1, 2 to S1/D2	
			25		mm	Pins 9, 10 to S1/D2	
			9		mm	D1, S2 to Baseplate	
			12		mm	Pins 7, 8 to Baseplate	
	Creepage Distance		11		mm	D1 to S2	
			6		mm	D1 to S1/D2	
			28		mm	Pins 1, 2 to S1/D2	
			30		mm	Pins 9, 10 to S1/D2	
			12		mm	D1, S2 to Baseplate	
			17		mm	Pins 7, 8 to Baseplate	
M_{BP}	Base Plate Material		AlSiC				



Typical performance: **GE12047CCA3**

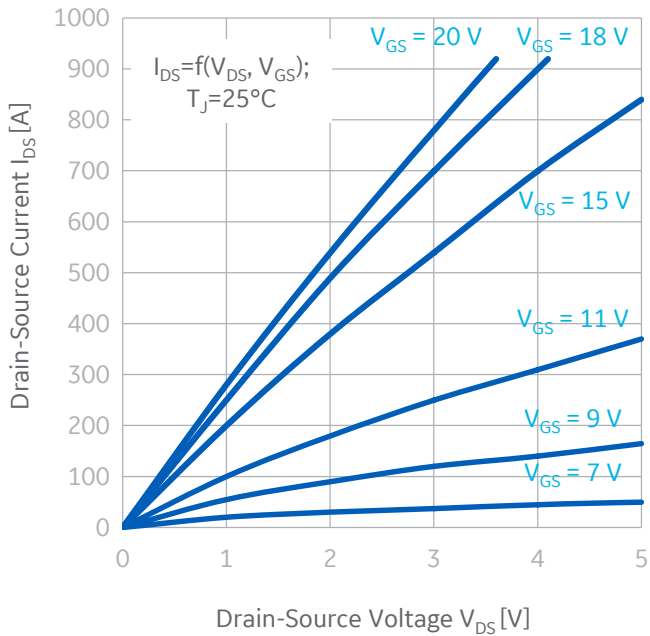


Figure 1: Output Characteristics (25°C)

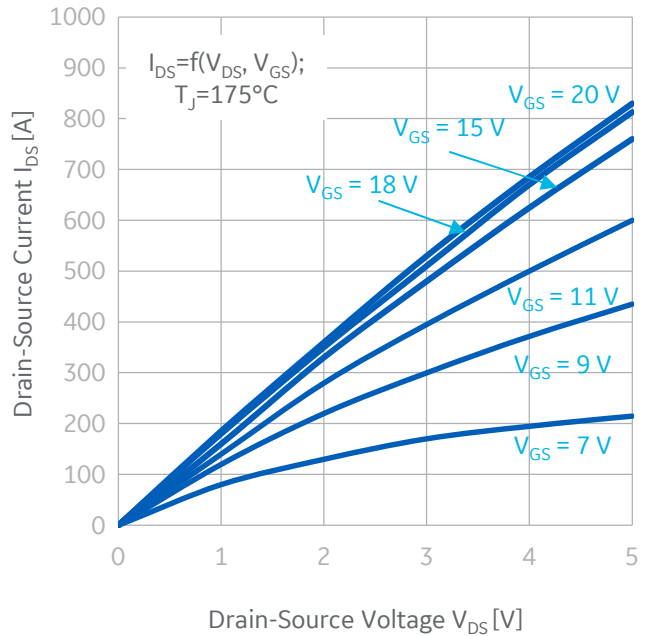


Figure 2: Output Characteristics (175°C)

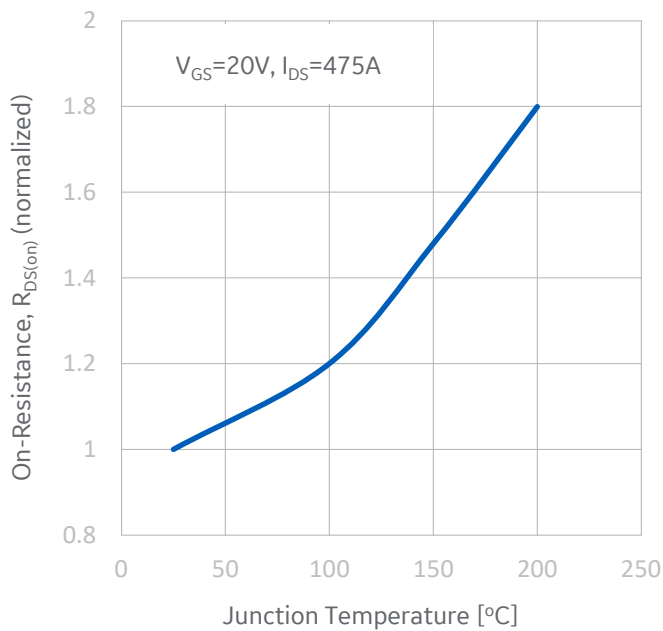


Figure 3: Normalized On-state Resistance vs. Temperature

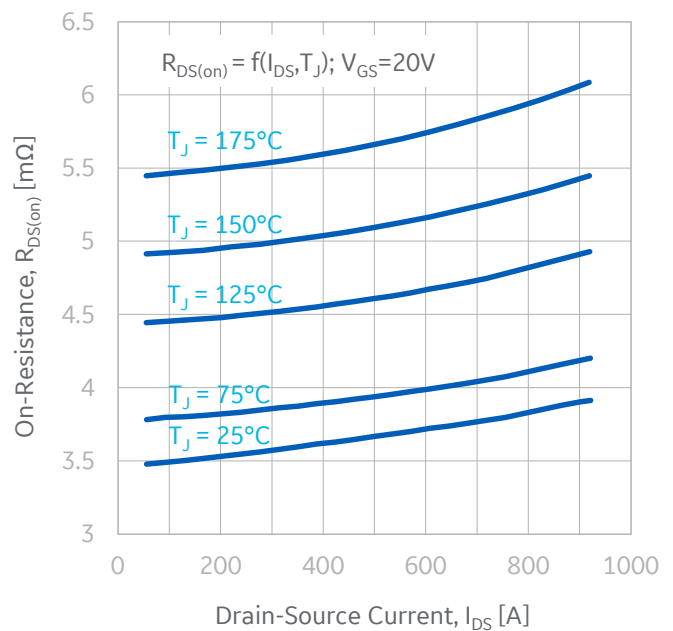


Figure 4: Module Drain-Source On-state Resistance



Typical performance: **GE12047CCA3**

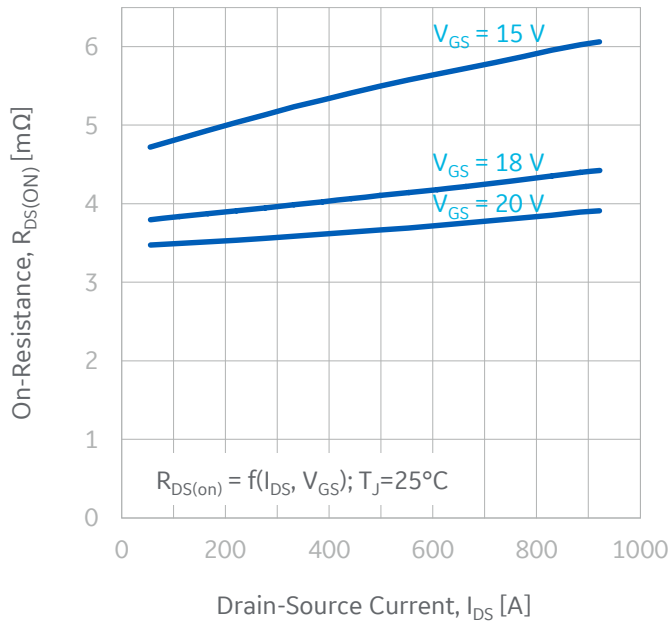


Figure 5: Module Drain-Source On-state Resistance

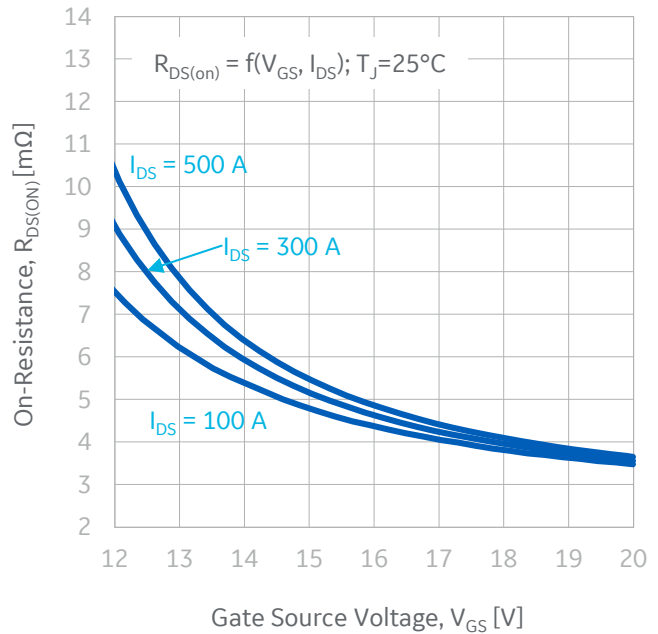


Figure 6: Drain-Source On-state Resistance vs. Gate Voltage

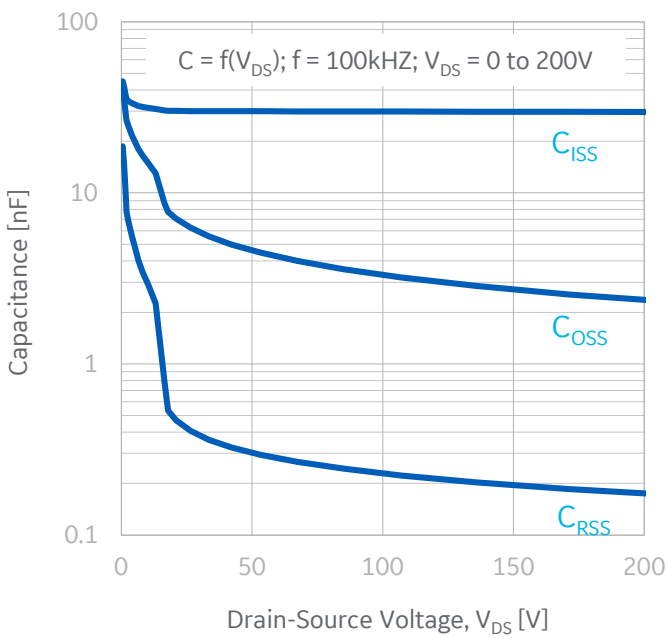


Figure 7: Input Capacitance to 200 V

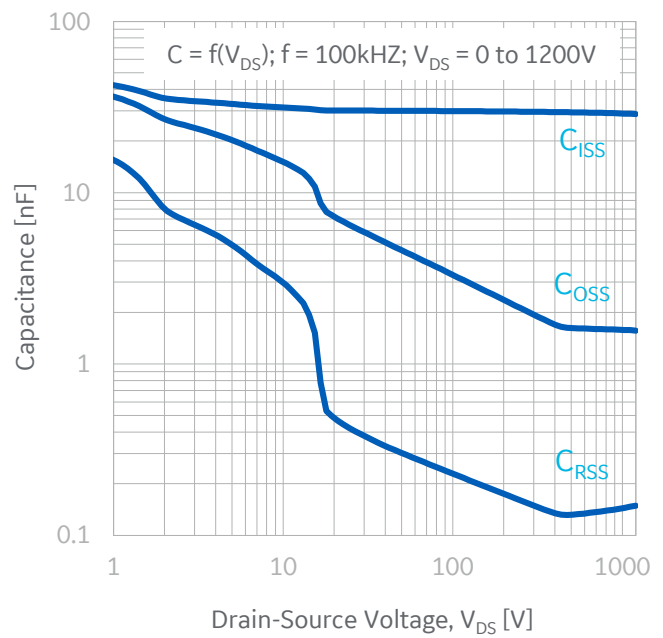


Figure 8: Input Capacitance to 1200 V



Typical performance: **GE12047CCA3**

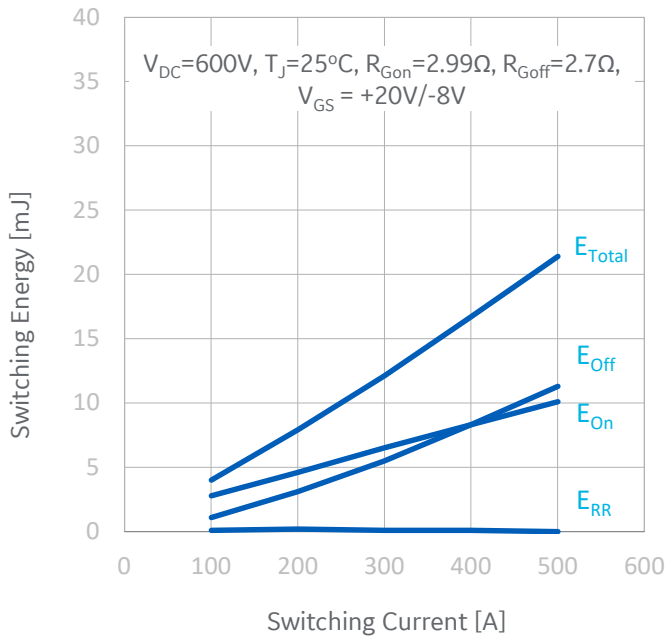


Figure 9: Switching Energy vs. Drain Current (600 V)

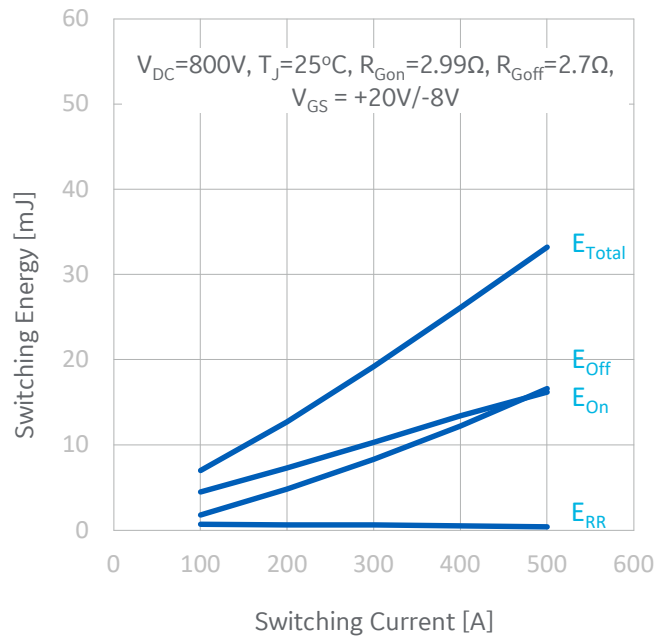


Figure 10: Switching Energy vs. Drain Current (800 V)

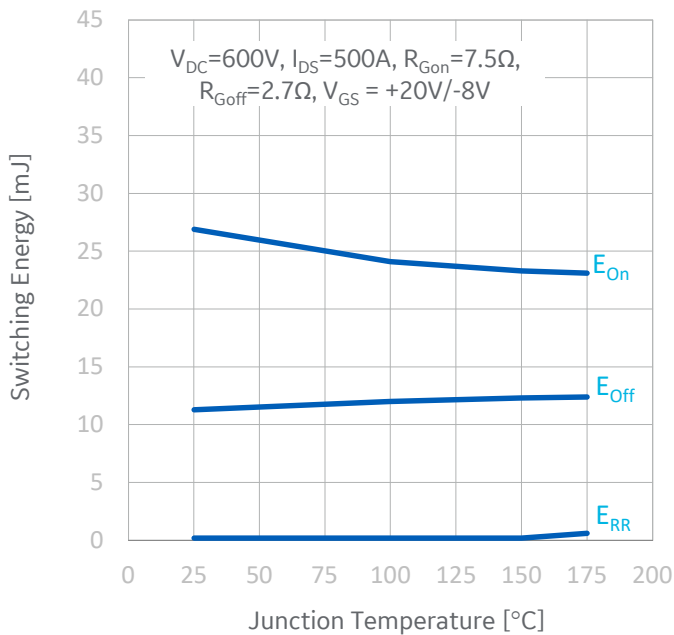


Figure 11: Switching Energy vs. Junction Temperature

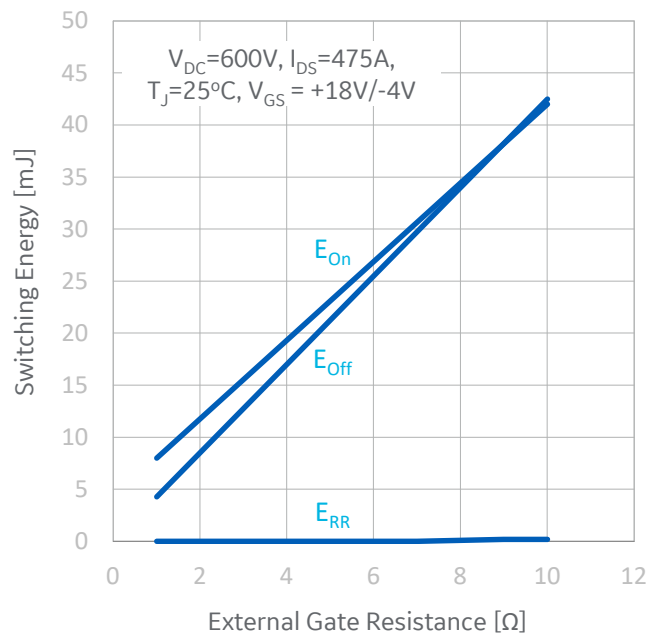


Figure 12: Switching Energy vs. Gate Resistance



Typical performance: GE12047CCA3

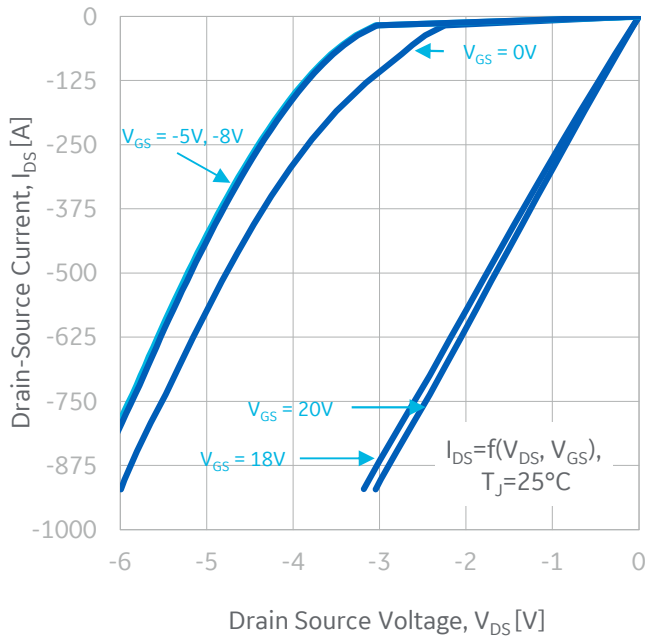


Figure 13: 3rd Quadrant Characteristics (25°C)

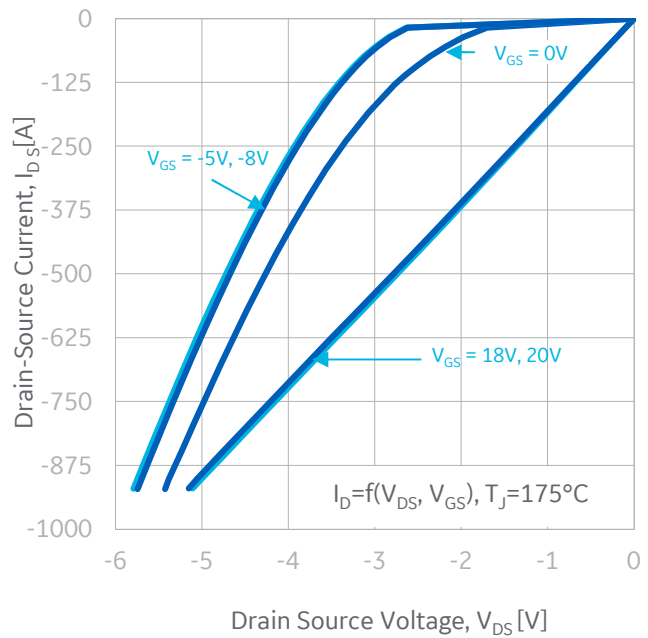


Figure 14: 3rd Quadrant Characteristics (175°C)

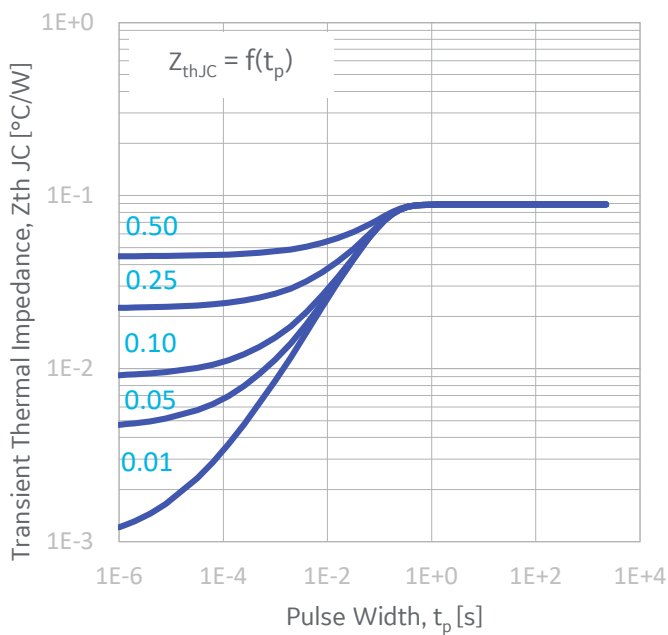


Figure 15: Transient Thermal Impedance

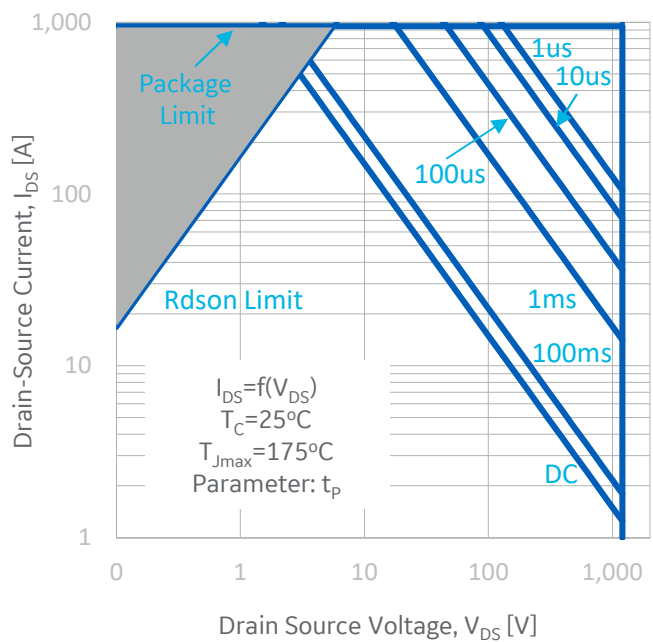


Figure 16: Forward-Bias Safe Operating Area



Typical performance: **GE12047CCA3**

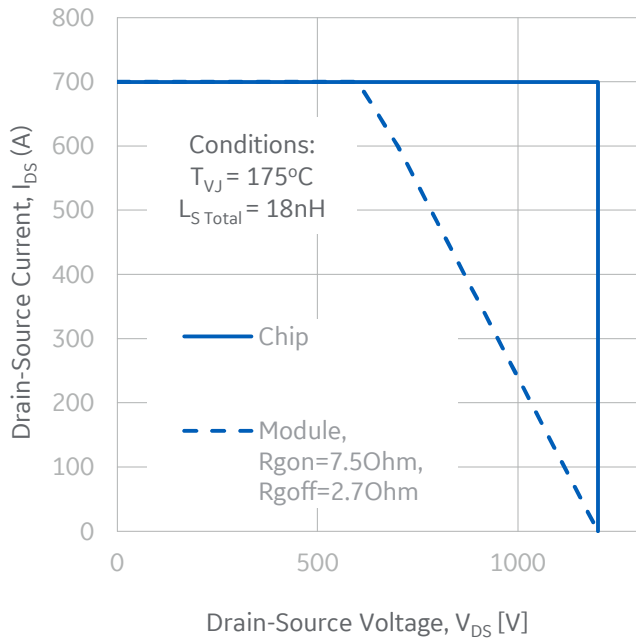


Figure 17: Reverse-Bias Safe Operating Area

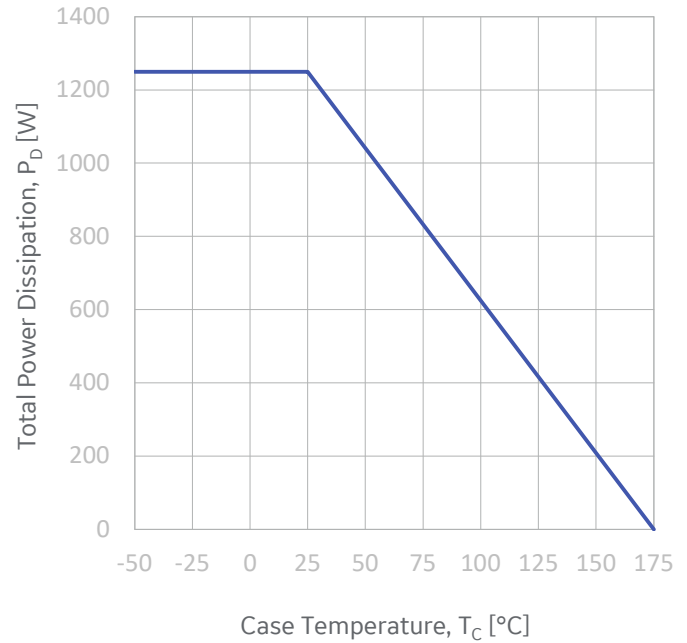
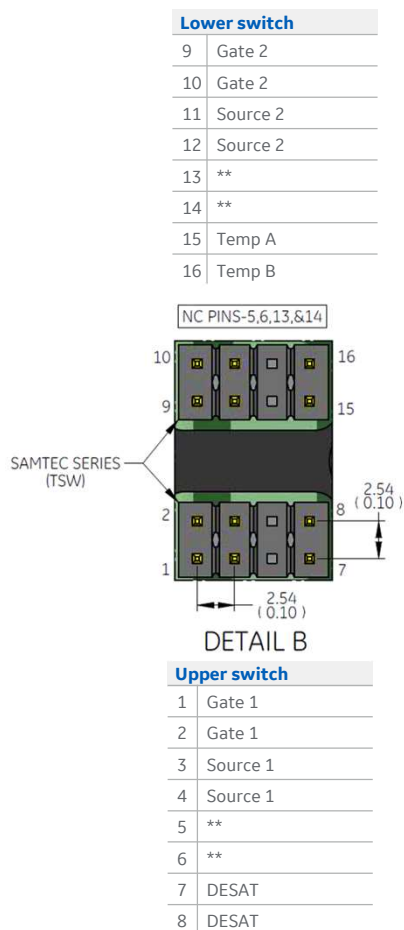


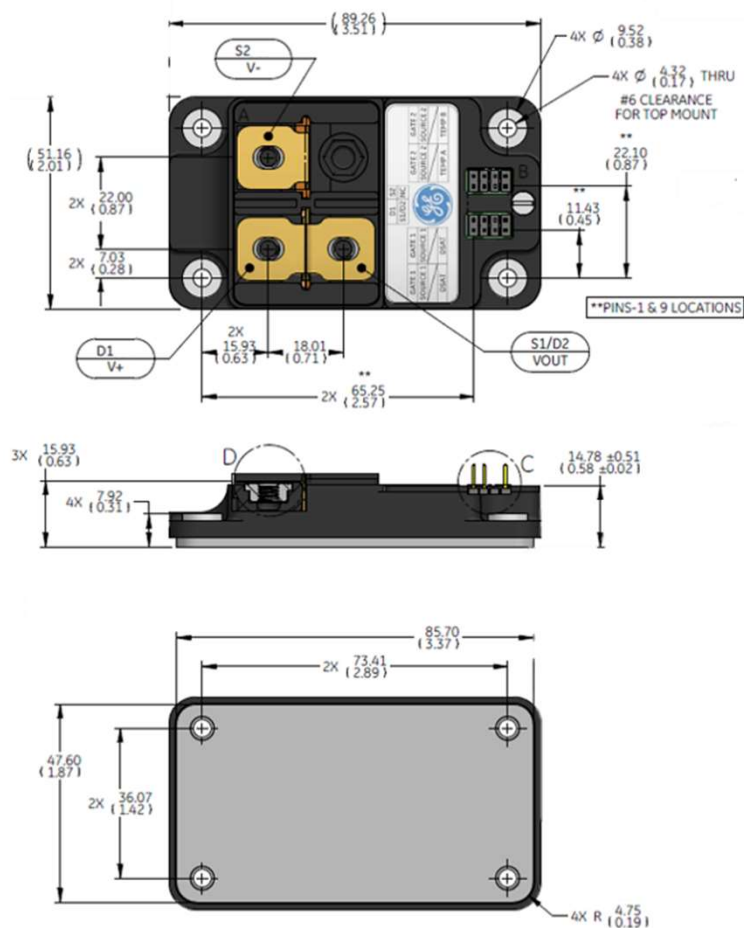
Figure 18: Maximum Power Dissipation vs. Case Temperature



Electrical interface outline drawing



Module dimensions (millimeters)



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Questions or need help designing in GE SiC Power modules? Please contact:

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Document revisions

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